144

SCIENCE

ELEVENTH YEAR.
VOL. XXI. No. 539.

JUNE 2, 1893.

SINGLE COPIES, TEN CENTS.
$3.50 PER YEAR, IN ADVANCE.

CONTENTS.

Entered at the Post-Office of New York, N.Y., as Second-Class Mail Matter.

Probably you take

THE ELECTRICAL ENGINEER.

Most people interested in Electricity do.

If you do not, now is a good time to begin.

It is published every Wednesday.

Subscription, $3.00 per year.

You can try it three months for fifty cents.

Address:

THE ELECTRICAL ENGINEER,

203 Broadway, - - - New York, N. Y.

Every reader of "Science" should subscribe for the

AMERICAN ARCHITECT,

THE OLDEST AND BEST

Architectural publication in the country. Interesting articles on architecture, Sanitation, Archæology, Decoration, etc., by the ablest writers. *Richly illustrated.* Issued weekly. Send stamp for specimen copy to the publishers,

Ticknor & Co., 211 Tremont St., Boston.

Newspaper Clippings. 25,000 in Stock. What do you want? Let us know. We can supply you. The Clemens News Agency, Box 2329, San Francisco, Cal.

BRENTANO'S,

Publishers, Importers, Booksellers.

We make a specialty of technical works in all branches of science, and in all languages.

Subscriptions taken for all American and foreign scientific periodicals.

Our Paris and London branches enable us to import at shortest notice and lowest prices. REPORTS OF SCIENTIFIC SOCIETIES, MONOGRAPHS, GOVERNMENT REPORTS, etc. *Correspondence solicited.*

☞ *All books reviewed in* SCIENCE *can be ordered from us.*

SEND FOR A SAMPLE COPY OF BOOK CHAT. A Monthly Index of the Periodical Literature of the World. $1.00 per year.

BRENTANO'S, Union Square, New York,

Chicago, Washington, London, Paris.

AMERICAN SCIENCE SERIES.

BARKER'S PHYSICS.	Advanced course.
REMSEN'S CHEMISTRY.	3 courses.
PACKARD'S ZOOLOGY.	3 courses.
MARTIN'S HUMAN BODY.	3 courses.
WALKER'S POLITICAL ECONOMY.	3 courses.
NEWCOMB & HOLDEN'S ASTRONOMY.	2 courses.
BESSEY'S BOTANY.	2 courses.
JAMES'S PSYCHOLOGY.	2 courses.
SEDGWICK & WILSON'S BIOLOGY.	

HENRY HOLT & CO., N.Y.

BUILDING BOOKS.

DRAWING INSTRUMENTS.

1893 Catalogue of Books on Building, Painting, and Decorating, also Catalogue of Drawing Instruments and Materials, sent free on application to

Wm. T. Comstock,
23 Warren St., New York.

GERMANIA A monthly magazine for the study of the German language and literature, is highly recommended by college professors and the press as "the best effort yet made to assist the student of German, and to interest him in his pursuit." Its BEGINNERS' CORNER furnishes every year a complete and interesting course in German grammar. $2 a year. Single copies 20 cents. P. O. Box 151, Manchester, N. H.

THE WINNIPEG COUNTRY;

OR,

ROUGHING IT WITH AN ECLIPSE PARTY.

BY

A. ROCHESTER FELLOW.

(S. H. SCUDDER.)

With thirty-two Illustrations and a Map. 12°. $1.50.

"This is a sprightly narrative of personal incident. The book will be a pleasant reminder to many of rough experiences on a frontier which is rapidly receding."—*Boston Transcript.*

"The picture of our desolate North-western territory twenty-five years ago, in contrast with its civilized aspect to-day, and the pleasant features of the writer's style, constitute the claims of his little book to present attention."—*The Dial.*

N. D. C. HODGES, 874 Broadway, N. Y.

Send 25 Cents

For a 3-months' trial subscription to

THE MOTHER'S NURSERY GUIDE,

The recognized authority on the care of infants and children. $2 per year.

Health, Education, Dress, Pastimes.

"Of incalculable value."—*N. Y. Herald.*

BABYHOOD PUBLISHING CO., Box 3123, N. Y.

What Our Subscribers Say.

DR. EDWARD BROOKS, PHILADELPHIA:
"I especially admire the conservative ground of the Journal while advocating those things that make for real progress in Education."

MRS. D. H. R. GOODALE, AMHERST, MASS.:
"If the teachers of the land do not give the Journal a hearty support, they are certainly very blind in their day and generation."

A KANSAS SUBSCRIBER SAYS:
"Of the number of papers which I take the Journal is the most welcome visitor."

FROM A NEW YORK SUBSCRIBER:
"Inclosed is a Post Office order for two dollar and fifty cents ($2.50), to renew subscription for JOURNAL OF EDUCATION. Must have the paper—'tis necessary for my health and happiness."

RURAL SUBSCRIBER IN MASS.:
"I find the Journal a most profitable and interesting paper, 'an ever present help' in time of school perplexities."

JOURNAL OF EDUCATION.

A. E. WINSHIP, Editor.

WEEKLY, $2.50 A YEAR. IN CLUBS OF THREE OR MORE, $2.00 A YEAR.

For $1.00 we will send you the Journal from now to Jan., 1894, provided you mention this paper.

New England Publishing Co., 3 Somerset Street, Boston, Mass.

The Boston Medical and Surgical Journal.

BOSTON, - - - - - MASSACHUSETTS.

A FIRST-CLASS WEEKLY MEDICAL NEWSPAPER. ESTABLISHED 1828.

Terms of Subscription: In the United States, and to Canada and Mexico, $5.00 a year in advance. To Foreign Countries embraced in the Universal Postal Union, $1.56 a year additional. Single numbers, 15c. Ten consecutive numbers free by mail on receipt of $1.00.

This JOURNAL circulates chiefly through the New England States, and is seen by the great majority of the profession in that important district. As a means of reaching physicians it is unequalled.

It is under the editorial management of Dr. George B. Shattuck, assisted by a large staff of competent coadjutors. Subscriptions and advertisements received by the undersigned, to whom remittances by mail should be sent by money-order, draft or registered letter.

DAMRELL & UPHAM, 283 Washington Street, Boston, Mass.

Pennsylvania Bedford Springs Mineral Water

For Liver, Kidney and Bladder Troubles.
For Gravel, Gall Stones, Jaundice.
For Dyspepsia, Rheumatism and Gout.
For Dropsy, Bright's Disease, Diabetes.
For Hemorrhoids, Etc.

It has been used medicinally and prescribed by physicians for nearly one hundred years.

DIRECTIONS:—Take one or two glasses about a half-hour before each meal.

Case One Dozen Half-Gallon Bottles, $4.50.
Case Fifty Quarts (Aerated), $7.50.

Bedford Mineral Springs Co., Bedford, Pa.

Philadelphia Office, 1004 Walnut St.

$5 to $15 per day, at home, selling **LIGHTNING PLATER** and plating jewelry, watches tableware, &c. Plates the finest of jewelry good as new, on all kinds of metal with gold, silver or nickel. No experience. No capital. Every house has goods needing plating. Wholesale to agents $5. Write for circulars. **H. E. DELNO & Co., Columbus, O.**

HALSTED'S ELEMENTS OF GEOMETRY. Fifth ed. $1.75.
HALSTED'S ELEMENTARY SYNTHETIC GEOMETRY. $1.50.
HALSTED'S MENSURATION: METRIC GEOMETRY. Fourth ed., postpaid, $1.10.
HALSTED'S LOBATSCHEWSKY'S NON-EUCLIDEAN GEOMETRY. Fourth ed., postpaid, $1.00.
HALSTED'S BOLYAI'S SCIENCE ABSOLUTE OF SPACE.
HALSTED'S GEOMETRY OF POSITION (Rigorously non-quantitative). To appear shortly.

Address GEORGE BRUCE HALSTED, Professor of Mathematics, University of Texas, Austin, Texas.

AGENTS WANTED ON SALARY

or commission to handle the New Patent Chemical Ink Erasing Pencil. Agents making $50 per week. Monroe Eraser M'f'g Co., X 22, La Crosse, Wis.

SCIENCE

NEW YORK, JUNE 2, 1893.

THE LATEST DISCOVERIES IN CHALDÆA.

BY THE MARQUIS DE NADAILLAC, PARIS, FRANCE.

ALL we knew of Chaldæa was a very few years ago completely legendary. Thanks to our scientists and to their discoveries, every day brings us new and important facts. Inscriptions allow us to learn the names of kings six thousand years old. Sculptures disclose to us their faces, their weapons, their vestments, the soldiers who followed them, the horses who bear them. We may be allowed to say, with a just pride, that the nineteenth century, now so near its close, deserves well of science, and that never have the progresses in every branch of human knowledge been either so numerous or so wonderful.

In September last, Mr. Maspero presented to the Académie des Inscriptions[1] the photograph of a Chaldæan sculpture dedicated by King Naramsin, who reigned in Babylonia and in the northern parts of Chaldæa some 3800 years before our era. The sculpture actually in the Museum of Constantinople is in a very mutilated condition but shows, nevertheless, a masterly execution and can well be compared with the celebrated diorite statues excavated at Tello a few years ago. Centuries must certainly have elapsed before men could have acquired such an art and attained the civilization it allows us to presume. Centuries are not less necessary to arrive at the agglomeration of population required for the execution of similar monuments and the establishment of a kingly power. It is difficult even to imagine the vast past we must embrace.

The last researches have brought to light numerous works of a more rude and primitive art which tend to confirm our opinion. Amongst the discoveries lately reported by that eminent Assyrian archæologist, Mr. Léon Heuzey,[2] those of Mr. de Sarzec at Tello are the most important, and date certainly from older times than King Naramsin. The discovery of three new fragments have completed the celebrated *stèle des vautours*, so named on account of the vultures which hover above the scenes depicted, and certainly one of the oldest and most remarkable works of the Chaldæan artists.

The monument presents on both sides figurative scenes. It was ordered, as the inscription runs, by E-anna-dou, King of Sirpoula,[3] son of A-Kourgal and grandson of Our-Nina, one of the oldest Chaldæan kings as yet known to us. One of the most remarkable scenes which it has been possible to reconstruct represents a funeral after a battle or a thanksgiving after a victory. The number of the human bodies shows the severity of the fight. An ox is provided for the sacrifice to be offered to the presiding deity. Other fragments show E-anna-dou at the head of his soldiers, disposed in six ranks, armed with pikes and carrying large rectangular shields of a very peculiar form.

The king himself is represented in the act of piercing with his lance a defeated enemy, or on his chariot charging the flying crowd. This last scene is unluckily much damaged. In both of them the king carries in his left hand a long lance. The chariot is a set of panels curiously put together; on the front seat are deposited a battle-axe and a quiver full of arrows. The wheels unluckily have been destroyed. E-anna-dou wears a kaunakes rolled round his legs and a woollen cloak thrown over his shoulders and chest. He has no beard but an abundant flow of hair partly brought up on his neck and partly hanging on his back. In all the scenes in which the king appears, besides his lance he carries in his right hand a crooked weapon of a very peculiar form, which Mr. Heuzey compares to the weapon or mark of dignity carried by the head of the Asiatic tribe Amou in the celebrated picture in an Egyptian tomb of the XII dynasty at Beni-Hassan near Minieh. It is obvious that such a fact is worth noticing. Detail we must not omit in all these Chaldæan scenes, the ground is strewn with human bodies symmetrically arranged, head against head, as a carpet for the warlike and savage king.

The other side of the stela presents sculptures presumed to be of a mythological character. A man or a god of gigantic size is the principal actor; his bulky head, his powerful frame, his broad shoulders, form a striking contrast with the figures already described. His hair is in the same style as the hair of King E-anna-dou, and is maintained by a large head-band; but what distinguishes him from the royal figure is a flowing beard plaited in the Assyrian fashion. The body is naked, the middle part alone is covered by some sort of cloth, of which little remains. In his hands the giant carries a massive club and a curious instrument, the use of which is difficult to guess; it figures an eagle whose claws rest upon a lion's head, the heraldic figuration of the town of Sirpoula, says Mr. Heuzey, to whom we leave the responsibility of the assertion.[4]

Under the principal personage is a very striking scene. Near the arm which carries the eagle is an immense net in which crawl in all possible attitudes, trying to escape through the meshes, a number of naked men whose features recall those of the captives under the feet of E-anna-dou and who evidently belong to the same race. We cannot tell the meaning of this scene; it brings to mind the curses of the prophet Habakkuk, comparing the defeated populations to fishes which the Chaldæan conqueror carries off in his net.[5]

With these sculptures were found fragmentary inscriptions difficult to decipher. We can, nevertheless, read "Isbanki," with its principal town, "Ner-ki-an," as a country subdued by King E-anna-dou. We find also mentioned two Chaldæan towns, Our and Erech, which are named in Genesis. They were, therefore, in existence and in communication with Sirpoula in those very ancient days, certainly many centuries before Moses.

E-anna-dou, we have said, was the grandson of Our-Nina, already king of Sirpoula. We are in possession of numerous antiquities which can leave no doubt of the existence of Our-Nina, bricks from an edifice probably a temple erected by him,[6] tablets with inscriptions,[7] other tablets with animal figures, small bronze statues, the fragments of an onyx vase, and sculptures which show the king amongst his court and family.

One of the fragments thus discovered shows a double procession marching towards a man placed alone in the middle. The name of Our-Nina, twice repeated, leaves no doubt as to the personage so figured. The king is naked with only a kaunakes rolled round his loins. His hair is closely shaven, and he carries upon his head a large basket similar to those carried by the slaves in the *stèle des vautours* and very similar also to the couffe in use with the Arabs till this day. In his devotion, the king is carrying the materials for the building of a temple. An inscription recently deciphered puts the fact above discussion. It reads thus: "Nina-Our, son of Nini-hal-dou, son of Gour-sar, the temple of

[1] Bul., Sept. 30, 1892.

[2] Bul. Acad. des Inscriptions, 12 Aout et 21 Octobre, 1892.

[3] Assyriologists look upon Sirpoula as the same town as Lagash, mentioned in some cylinders also found by Mr. de Sarzec.

[4] The giant himself, according to our eminent Orientalist, is the god or hero Isdoubar, figured in a very old relievo discovered a few years ago by Mr. de Sarzec.

[5] "They take up all of them with the angle, they catch them in their net and gather them in their drag. Therefore they rejoice and are glad. Shall they therefore empty their net and not spare continually to slay the nations?"—Habakkuk, C. IV., 15-17.

[6] Découvertes en Chaldée, Pl. xxxi., Fig. 1.

[7] Revue d'Assyriologie, T. II., p. 147.

the god Nin-ghir-sou has erected." We read, also, in another inscription behind the head of the king: "Nina-Our, King of Sirpoula," and a little above his knees: "from Magan in the mountain quantities of wood he has ordered," and after the last personage figured: "the temple of the goddess Nina he has erected."[1] We are evidently in presence of a very pious prince, and we know from other sources that he erected or repaired a certain number of temples dedicated to his gods. All the figures and inscriptions show a most primitive art, inferior to that dating from the days of E-anna-dou. They are nevertheless of high value as historical and genealogical records.

The importance of these discoveries cannot be overrated. That importance resides not only in the insight they bring on the customs, wars, and religions of nations whose very names were unknown but a few years ago, but also in the greater antiquity we must now accept for the origin of man himself. The dates given for the creation must be amended, as we know now with certitude, that in those days men and nations already existed in numbers, towns were built, monuments were erected, arts were flourishing, kingdoms already powerful were in existence, and we find both in Asia and in Africa traces of a civilization which centuries alone could have reared and maintained.

[1] Amiaud, "Records of the Past," T. I., p. 64; Jensen, "Keilenschriftliche Bibliothek," T. III., p. 10.

AN EXPERIMENTAL BASIS FOR LITERARY CRITICISM.

BY CONWAY MAC MILLAN, UNIVERSITY OF MINNESOTA, MINNEAPOLIS, MINN.

THE volume, entitled "Analytics of Literature," just published by Ginn & Co. of Boston, seems to the writer so epoch-making a work that he takes advantage of the courtesy extended by *Science* to direct the attention of scientific men in general and biological students in particular to the new and brilliant application in it of the familiar methods of research which they have themselves used in other departments of investigation. The truth is that there is the emergence of a new science — the science of experimental criticism, or, if one likes, the science of style-morphology, embryology, and physiology. It is a most noteworthy volume, and though unpretentious and perhaps marred by departures here and there from the strict scientific method, it will take its place with such a work as that of Fechner, in which he brought recalcitrant psychology under the laws of empiricism, and banished the intuitional and closet-metaphysician in the ratio in which he introduced the laboratory method of psycho-physics and the experimental psychologist of the school of Wundt. No more far-reaching scientific work has been done in America than the reduction, in this book by Dr. L. A. Sherman, of so mysterious a matter as literary style to the basis of a department of experimental science. But after an acquaintance with the method and an application of it, during the ten years past in which it has been laboriously and carefully developed by its originator, I have no hesitation in pronouncing the work an extraordinary and inspiring advancement of biological methods into a field where, oddly enough, they have not before been employed.

The new point of view is simply this: style is an institution. It may be considered apart from the message which the writer wishes to convey. Under such an analysis style is found to obey the laws of other institutions or organisms. It is a matter of evolution. It is in any case a structure of which the phylogeny and the ontogeny may be calculated. In the child, one may study the ontogeny of a style, and of children's phases of sentence development the author of "Analytics of Literature" gives some valuable examples. And in the literature of the English-speaking peoples there is a vast storehouse of palæontological material from the study of which, after comparison with the ontogenetic development, it is possible to determine some of the laws of style-evolution. Thus a foundation for a style taxonomics is laid and one finds that, as one should expect, all the well-known laws of heredity in general and of progress, degeneration, variation, reversion, or atavism, persistence of type and modification of type in particular, apply to literary styles precisely as to organisms. It becomes possible to determine a style, not in the old intuitional manner of literary art as indicated in Sainte Beauve, Arnold, or Lessing, but in the precise manner of the zoölogical monograph. It becomes possible to establish genera, species, tribes, orders, if one will, of literary style, and the whole matter of literary criticism at one touch passes over into the domain of natural science, just as music so passed in the thought of Schopenhauer and Wagner, metaphysics under the hand of Wundt, biology by the genius of Aristotle, Bacon, and Darwin.

The genesis of such a work must be of interest. As indicated in the preface it was a development, not an inspiration. The first published paper that pointed out the objective method in criticism, so far as known to the writer, was that of Sherman in the *University Studies*, October, 1888.[2] Here the matter of enquiry was the changing length of the sentence in English prose and a number of statistics were presented. It was shown that there has been a progressive shortening of the sentence from early pre-Elizabethan prose to the present. Some data are added here by way of illustration. They are taken from both the *Studies* article and from the recent volume.

Average number of words to the sentence in various English writers, computed from prose, on the basis of five hundred sentences.

Chaucer.	40.+	Browne,	33.40
Thomas More.	52.+	Fuller,	32.80
Lyly,	52.22	Addison,	37.90
Roger Aschman,	42.+	"Junius,"	31.90
Sidney,	50 65	DeQuincy.	32.28
Fabyan,	63 02	Matthew Arnold,	37.
Spenser,	49.82	Lowell,	38.
Hooker,	44.+	Pater,	36 5
Bacon,	22.	Macauley.	22 45
Dryden,	45.26	Channing.	25.73
Bunyan,	37.50	Emerson,	20.58
Milton,	60.80	Bartol,	15.97

These averages once established may be tried in other parts of the works of any author and will be found practically constant. For example, in Macauley's "Essays" the average length of the sentence is 23.+. Testing by the "History of England" it was found that in this the average of the 41,579 periods counted is 23.43 words per sentence. Thus it can be shown in any author who has acquired a style that five hundred or a thousand sentences taken at random will establish a sentence-norm for that author and from this norm the variation will be slight. Disparities, too, are greatest in more ancient styles, indicating their less complete organization. For example, in Chaucer the average of Melibœus is 48.+, while that of the Parsonn's tale is 36.+, an almost unparalleled discrepancy.

It is possible, then, for any author to plot a curve of sentence-length, and when this is done the surprising fact stands forth that the average is brought about by "evening-up" a comparatively large number of sentences only a little shorter than the mean with a comparatively few sentences excessively long. Since the long sentence is clearly shown by palæontologic investigations to be the older type in any literature, it appears that in modern stylists, even, there is an atavistic tendency, and this is capable of beautiful and instinctive comparison with the persistent styles of low type that can be picked up anywhere — in newspaper-advertisements or in cheap novels — where, if there is an independent style at all, it will be one of older and lower organization.

Even in the preliminary analysis of sentence-length, singular and unintelligible facts have been discovered that demand further investigation before their import can be known. DeQuincy is peculiar in the number of prime-sentences, those in which the number of words is indivisible by any quantity but the number itself and unity. Curious lapses into ancient manner in moderns and astonishing forecasts of modern manner by ancients

[2] On the Sentence-length in English Prose, pp. 119-130.

—as, for instance, in the case of Bacon — attract one's attention. But space permits of no extended indication of these points.

Next to the shortening of the sentence, a decrease in predication is a striking fact in the evolution of the prose-style. While in earlier writers the per cent of simple sentences is small, it rises rythmically to a high average in modern stylists. The following examples will illustrate:—

	Per cent Simple Sentences.		Per cent Simple Sentences.
Chaucer,	4	Shaftesbury,	27
Spenser,	11	DeQuincy,	14
Hall,	7	Macauley,	39
Sidney,	10	Channing,	31
Hooker,	12	Newman,	16
Barrow,	15	Emerson,	37
Addison,	12	Lowell,	23
Bacon,	19	Grant,	31
Bunyan,	10	Everett,	32
Bolingbroke,	13	Bartol,	45

The laws of shortening and simplifying the English prose-sentence may be derived from comparative morphological studies in styles, or better by the assistance of ontogenetic or embryological work. The latter method is called in by Dr. Sherman in the series of comparisons between the style of speech of the child and the literary styles in the phylogenetic series. The stages in either case are found to be (a) monosyllabic exclamation, (b) predication, (c) co-ordination of predications, (d) sub-ordination of some predications to others, (e) suppression of less important predications. Examples from the early lispings of childhood are brought side by side with others selected from the field of English prose and a statistical enquiry, most subtle and ingenious, is instituted into the various percentages of illative, temporal, causal interior and exterior conjunctions in different writers. The result, simple as it seems when once fairly grasped, is no less splendid an achievement of the biological method in its new application. There is in the child, as it learns to talk, a recapitulation of the phases through which the English writers of prose have passed in their development of the modern style. The record of the palæontological series tallies with that of the embryological and one can explain the changes from the earlier styles to the later by the same laws that one sees at work in the child as he learns the art of speaking and of writing.

In the discussion of poetry the same scientific method may be used, and its employment is indicated, but somewhat less fully, by Dr. Sherman. In the portion of the "Analytics of Literature," which is particularly devoted to the poetic side of English, the most notable discovery is doubtless the law of intensification, through which, when associations were few, the poetic idea demanded a whole sentence for its vehicle, as in Chaucer; but as the association value of words increases the poetic idea can be carried by clauses, as in Shakespeare, by phrases as in Keats or Shelley, and, finally, by single words, as excellently illustrated in Browning. This discovery is made the basis of a scientific analysis of different poetic styles and the results obtained while new are of the deepest value. Things before mysterious and the subjects of vatic utterance by the various critics, become suddenly transferable to the solid ground of experiment and calculation. Poetry is no longer presented to one as something to be intuitionally appreciated but as an object of experience and of analysis after the ordinary methods.

On the whole, it is not possible to commend too highly this new departure in a field which has long lain in darkness, awaiting the light of science to make its laws and phenomena generally apparent. The adoption of such clear-cut, substantial, experimental foundation in rhetorical courses in colleges and schools cannot but be of the highest utility. It is evident, furthermore, that a vast untried territory is now discovered to those who wish to engage in useful research. It becomes apparent how halting and poor is former critical method when one notes what tremendous conquests of unknown facts are possible through this single pioneer work. The study of literature — after the usual objection and objurgation from those not yet in sympathy with the unifying power of the scientific method—promises to take its place not as an art, but as a science of the biological series. Too much praise can hardly be laid upon the writer of this work which so definitely hands literary criticism over into the hands of scientifically-minded men.

IN REGARD TO COLOR-BLINDNESS AMONG INDIANS.

BY LUCIEN I. BLAKE AND W. S. FRANKLIN, PHYSICAL LABORATORY, UNIVERSITY OF KANSAS, LAWRENCE, KAN.

THE fact that blindness to certain colors exists among civilized people, is well established; also the percentage of cases to be found among males has been determined with considerable probability for the races of Europe and America. There has been much diversity in methods of testing, and the results of many reported determinations might well be called in question. Still, it is probably not far from the truth that four out of every hundred males are more or less deficient in color-sense. Of females, there have been reported (B. J. Jeffries, M.D., 'Color-Blindness," p. 85) as examined in Europe and America, 39,828, and of these only 60 were color-blind, or two-tenths per cent. Of both males and females, 156,732 have been tested, and of these 5,417, or 3.52 per cent, were color-blind. These statistical facts have naturally excited interest and discussion. If so large a number as four out of every hundred are unable to distinguish colors, there arises, of course, a practical question, important to the railroads, marine, etc.

The gravity of this fact is already recognized more or less in all countries, by the test-examinations for color-blindness among employés. But there is in these statistics also much of interest to scientists.

Most cases of color-blindness are found to be congenital and are incurable. Many have been produced by disease, some by violent concussions in accidents, and some by excessive use of tobacco and alcohol. Temporary blindness to violet may be induced by santonine. From these facts several interesting questions have suggested themselves to us. If color-blindness follows the laws of heredity, is it on the increase or decrease? Further, is it a product of civilization? The first of these queries can be answered only by statistical data extending over long periods of time. The second naturally suggests a comparison: first, of the color-sense of civilized nations among themselves; and second, of civilized with uncivilized peoples.

Of tests on native tribes, we can find but two recorded — those of Dr. Favre on some tribes in Algiers, and those of Dr. Fox on 150 American Indians, but where we do not know.

First, for the comparison of civilized tribes among themselves we have calculated the following percentages from tables reported by Dr. Jeffries:—

Countries.	No. Examined.	Per Cent Color-Blind.
Austria	5,250	3.79
Denmark	5,840	3.74
Belgium	8,106	4.13
Holland	2,300	1.48
Finland	1,200	5.00
Norway	205	4.88
Sweden	32,504	3.73
Switzerland	3,024	5.36
Germany	6,344	4.19
Russia	12,830	3.30
Italy	2,065	2.32
England	16,431	3.75
United States	44,844	3.64

Average per cent, 3.76.

No great reliance can be placed upon these results. The numbers examined are too small, the methods of testing not uniform or equally reliable. However, the probabilities of error are almost equally distributed, so that the conclusion is fairly well

established, even without great accuracy of data, that among civilized nations color-blindness is almost equally common.

Second. Among uncivilized people Dr. Favre's results from Algiers, already alluded to, show 414 examined, and only 2.6 per cent color-blind.

Dr. Fox reports 161 young Indians in the United States tested, and only 1.81 per cent are color-blind.

These percentages, so low compared with those for civilized people, suggested to us the thought that color-bindness may be a product of civilization, and these have led to our own tests, here reported.

At the Haskel Institute, at Lawrence, Kansas, are several hundred Indians, representing many tribes. These we have recently tested by Holmgren's method, with Berlin worsteds. 418 have been examined — 285 males and 133 females — only three cases of color-blindness exist, or only $\frac{7}{10}$ of 1 per cent. These were males, and all full-blooded Indians. The tribes were Pottawatomie, Pawnee, and Cheyenne. Of these two had defective color sense for red and one for green.

The Indians were almost evenly divided as full-bloods and half-breeds. It seemed to us that the half-breeds showed more instances of blunted color-sense than the full-bloods. This was evidenced in more frequent and prolonged hesitation among them in comparing the colors, than among the full-bloods. If this be confirmed by more extended examinations, it would, in conjunction with the low percentages obtained as above, be a strong argument for the theory proposed by us, that defective color vision is in some way the product of civilization. To this conclusion, our tests, at least, seem to point. The data are too meagre at present to propose any explanation why defective color-vision comes with civilization. It is not accidental that nearly every case of color-blindness is for red, fewer for green, and seldom one for violet.

What is the meaning, that the defects are thus limited at present, at least, to the lower end of the spectrum? The Helmholtz-Young theory of color perception will locate the affection in the layer of rods and cones responding to the first of the three primary sensations of color. But why this special layer is, with few exceptions, the only one affected, has at present no explanation. Also why the percentage among females is so small, has no explanation.

The law of heredity indicates increased sensitiveness in those nerves which are subjected to special use through many generations. It seems reasonable to look for an explanation of the more perfect color-sense in females, to this fact,— but whether this law of heredity will increase the percentage among males cannot be foretold without an enormous increase of data.

The theory here proposed is that defective color-sense is a product of civilization with the use of tobacco as a possible factor. The non-use of tobacco would explain also the low percentage of color-blindness among females. This theory leads to the thought of increase of color-blindness in males in the future generations.

THE VERTICAL SCRIPT.

BY W. H. METZLER, BOSTON, MASS.

I PRESUME that most of the people of this country were taught to write the slanting script, according to a code of rules such as that given by Spencer, DeGraff, and others. It would be interesting to know what proportion have continued consciously or unconsciously to observe those rules, and what proportion have forsaken them for a position of body, pen, and book more suited for rapidity and ease, and no doubt in many cases better from an hygienic standpoint.

Little observation will be required to convince us that there are but few who observe the rules they were taught.

Some years ago I had charge of about one hundred and twenty-five pupils in writing, who had been taught the slanting script according to Spencer's rules. After using that method a short time, I became convinced that the collapsed position which very many assumed was due to the methods. When allowed to write as they pleased, about 5 per cent of them observed all the rules, about 70 per cent observed part of them, but not all, and the remainder apparently observed none of them. Those pupils placing the book directly in front, with about an equal amount of both forearms on the desk, sat most erect and wrote a script varying but little from the vertical, and those turning the right side, placing the right forearm on the desk parallel to its edge, sat least erect. Observing this, and my own experience having taught me that with paper directly in front I must sit more erect, could write faster, and with a good deal more ease than with it at the right, I directed the pupils to place their writing-books in front of them, and found beneficial results follow in that the body was kept more erect and the writing on the whole much improved. At that time I had not heard of what is now known as the *vertical script*.

It, together with the many evils resulting from the methods so commonly used in this country, was first prominently brought to my mind while attending a course of lectures given by Dr. W. H. Burnham at Clark University in 1891-92. The substance of which is contained in an invaluable paper published in the *Pedagogical Seminary*, Vol. II., No. 1. Dr. Burnham has made a thorough study of the subject of school hygiene, and his paper gives, besides a comprehensive bibliography, the opinions and conclusions of the best writers and investigators of different countries, and should be in the hands of all teachers and school boards.

The following are some of the rules given by Schubert for writing the vertical script: —

1. Straight-central position of the tablet or copy-book. 2. Two-thirds of both forearms should rest on the desk in symmetrical positions, meeting at right-angles and forming an angle of 45° with the edge of the desk. The elbows should be about a hand's-breadth from the body. 3. The hand should rest on the outer edge of the nail of the little finger. The index finger should form a slightly convex bow. 4. The pen-holder should be long and grasped not too near the pen. Its upper part should not rest against the index finger, but on the middle of the hand between the thumb and index finger, and should point towards the elbow rather than towards the shoulder or breast. 5. The arm as it moves toward the right in writing should be moved as a whole, so that all positions that it occupies will be parallel. 6. After each line the paper should be correspondingly raised, so that a proper distance between the point of the pen and the edge of the desk be preserved. 7. The lines should be short. 8. The lines joining the eyes and the shoulders should be horizontal, and the eyes from 30 to 35 centimetres from the paper.

Since hearing the lectures and reading the paper, I have made some observations to ascertain whether those placing the book directly in front of them sit more erect than those who place it at the right, and though I did not find many who used the straight-central position, yet I found that a larger per cent of those placing the book in front sit erect than of those placing it at the right.

Since so many evils are due to poor methods in writing, it would seem that the subject should receive far more attention than has heretofore been given to it, and the vertical script be given a thorough test at least. The fact that no two hand-writings, like no two faces, are exactly alike would indicate that, after a few general instructions to secure a healthful position of the body, no complex set of rules should be given. Each person will then develop that particular hand-writing most suited to him.

DISINFECTANTS AND DISINFECTION.

BY DAVID BEVAN, M.D., PHILADELPHIA, PA.

THE question of disinfectants and disinfection has come to be of as great practical importance as it is of scientific interest. The term disinfectant is by the laity, and to some extent by the medical profession, grossly misused in being considered as synonymous with antiseptic and deodorant, since science has so ably demonstrated the nature of the contagium in infectious and contagious diseases, only such agents as are capable of destroying

the contagium are to be designated as disinfectants. An antiseptic retards or prevents the development and pullulation of the organism; but the organism is not destroyed. A deodorant merely destroys odors, but does not necessarily have any effect whatever upon the organism.

The cholera scare of last summer inaugurated a season of apprehension and an unprecedented demand for disinfectants.

The universal cry for a disinfectant has given birth to a number of compounds, the virtues (?) of which are only equalled by the number and chemical incompatibilities of their ingredients. These compounds are often efficient deodorants; sometimes they are antiseptics, but never are they disinfectants.

To consummate the process of disinfection, there are two essential requirements, 1st, that the substance to be acted upon is infected; 2d, that the agent employed is a disinfectant. During an epidemic or in sporadic cases of infectious diseases, the efficiency and adaptability of a given disinfectant will depend greatly upon the nature of the substance to be disinfected and also as to the presence or absence of spores.

The various subjects for disinfection will now be considered and under each the most available and efficient disinfectant.

Excreta, Sputum, or other Discharges. By far the best disinfectant that we possess is the bichloride of mercury; as in solution of 1: 1000 it destroys anthrax spores after a few minutes' exposure. In using this salt three precautions are to be observed: 1st, its extremely poisonous character; 2d, its corrosive action on all of the common metals, and 3d, the facility with which it combines with albumen to form an insoluble, inactive compound.

That the dangers arising from poisoning may be reduced to a minimum, it will be found expedient, 1st, to color the tablets or solution, whichever it may be, with one of the aniline dyes, and further to keep the salt in a peculiarly-shaped bottle, conspicuously labelled. In reference to the second precautionary measure, it should never be used except in metallic vessels. To prevent the salt combining with albumen acidulate the solution. In Wilson's "Hygiene" we find the following formulæ recommended by the Local Government Board of Great Britain. Dissolve half an ounce of corrosive sublimate, one fluid ounce of hydrochloric acid, and five grains of commercial aniline blue in three gallons of water.

Carbolic acid, in a five per cent solution, as a disinfectant for excreta, though very popular, is, taken all in all, extremely unsatisfactory. Upon adding such solution to a quantity of excreta, the additional dilution and the presence of large quantities of organic material decidedly interfere with its action and render it unreliable. If carbolic acid be used, it should be according to the following formula:—

Carbolic acid	10 parts.
Glycerine	10 "
Water qs.	100 "
Mix.	

Expose the excreta to an equal quantity of this solution for at least six hours.

Chloride of lime has been highly recommended in a solution containing four per cent of available chlorine. Although the chloride of lime will not destroy the more highly resisting forms of contagium, e. g., anthrax spores, it is a most excellent agent for disinfecting the stools of cholera Asiatica and typhoid fever. To make the above strength solution, dissolve six ounces of the best chloride of lime, containing twenty-five per cent of available chlorine, in one gallon of water.

Underclothing, bed linen, towels, napkins, etc., if of little value should be destroyed by fire, otherwise, we may expose them, in a suitable apparatus, to flowing steam for fifteen minutes or resort to boiling for twenty minutes or immersing in a 1: 1000 solution of the bichloride of mercury.

For disinfecting the hands, we recommend one of the following methods:

The nails should be short and clean.

The hands are thoroughly washed for several minutes with soap and water, the water being as warm as can be comfortably borne, and being changed frequently. Use a brush which has been sterilized by steam. The excess of soap is washed off with clean warm water. The hands are immersed for one or two minutes in a warm saturated solution of permanganate of potash, and are rubbed over thoroughly with a sterilized swab. Then place the hands in a warm saturated solution of oxalic acid until they are completely decolorized. Wash the hands with a sterilized salt solution of water. Immerse the hands for two minutes in a 1: 500 solution of the bichloride of mercury.

The above method is used by Welch of the Johns Hopkins Hospital.

Professor Keen, of the Jefferson Medical College Hospital, uses the following method:—

The hands are washed with soap and warm water; the nails, being cleaned and trimmed with a knife, are then scoured with a sterilized brush. All loose skin about the nails is removed. The hands are again washed in warm water but without soap. Immerse the hands in alcohol for two minutes and briskly rub one over the other. They are then immersed in a 1: 1000 solution of the bichloride of mercury. This latter method is a most excellent one. The writer has tested the skin and nails of the hands, after being sterilized as above directed, and also the cat-gut and silk, which were handled by the professor or his assistants, with almost invariably negative results.

To disinfect the general surface of the body, wash with a 1: 2000 solution of the bichloride of mercury and then bathe in warm water.

Should a person die of an infectious or contagious disease, the body must be cleaned and disinfected before removing from the isolation quarters. To disinfect the body, first wash it in clean water and then wrap in a sheet thoroughly saturated with a 1: 500 solution of the bichloride of mercury.

So long as the source of infection remains, there is a continuous reproduction of the poison. It is impossible to disinfect a room during its occupancy by a person suffering with an infectious or contagious disease, by liberating gaseous disinfectants, as any such agents of sufficient potency will kill the patient. However, the wall, furniture, etc., may be washed with a 1: 2000 solution of the bichloride of mercury and then with warm water. In such instances, the greatest reliance is to be placed upon cleanliness and ventilation. If these two provisions be thoroughly carried out, offensive odors will be abolished, or prevented from accumulating in such force as to be disagreeably perceptible. Ventilation should never be effected through another room or hallway, but communication established and maintained with the outside air and in such a manner as not to create draughts. As soon as the infectious nature of the disease is determined, the patient should be isolated. The room should contain as few articles as possible. All upholstered furniture and drapery should be removed and their places supplied by wooden articles and simple muslin or linen curtains. The attendant or attendants upon the sick should not be permitted to associate with other persons or to leave the isolated portion of the dwelling without first disinfecting their person and putting on clean clothes from the skin out. The sending of unnecessary articles into the room, such as extra napkins, towels, etc., should be strictly interdicted. Everything coming from the sick quarters should be disinfected by one of the methods already indicated.

To disinfect the vacated room or rooms, first disinfect and remove all the furniture, etc., then close all cracks and crevices about the windows and doors, leaving one door open; place in the room a tub in which there are about three inches of water. In the centre of the tub place a large shallow pan, preferably of iron, containing two pounds of sulphur for every one thousand cubic feet of air space in the room. Set fire to the sulphur and drop into the tub, about the sulphur pan, several very hot bricks. Quickly leave the room, close the door and all crevices about it. The infected quarters are now air-tight, sulphurous acid gas is being generated, so also is steam, which will facilitate the action of the gas and secure better penetration. The room is to remain thus for twenty-four hours, then to be ventilated freely; the surfaces washed with a 1: 1000 solution of the bichloride of mercury and lastly with warm water.

SCIENCE:

PUBLISHED BY N. D. C. HODGES, 874 BROADWAY, NEW YORK.

SUBSCRIPTIONS TO ANY PART OF THE WORLD, $3.50 A YEAR.

To any contributor, on request in advance, one hundred copies of the issue containing his article will be sent without charge. More copies will be supplied at about cost, also if ordered in advance. Reprints are not supplied, as for obvious reasons we desire to circulate as many copies of *Science* as possible. Authors are, however, at perfect liberty to have their articles reprinted elsewhere. For illustrations, drawings in black and white suitable for photo-engraving should be supplied by the contributor. Rejected manuscripts will be returned to the authors only when the requisite amount of postage accompanies the manuscript. Whatever is intended for insertion must be authenticated by the name and address of the writer; not necessarily for publication, but as a guaranty of good faith. We do not hold ourselves responsible for any view or opinions expressed in the communications of our correspondents.

Attention is called to the "Wants" column. It is invaluable to those who use it in soliciting information or seeking new positions. The name and address of applicants should be given in full, so that answers will go direct to them. The "Exchange" column is likewise open.

IRON AND ALUMINIUM IN BONE BLACK: THEIR QUANTITATIVE DETERMINATION.

BY DR. F. G. WIECHMANN, COLUMBIA COLLEGE, NEW YORK.

THE determination of iron and aluminium in bone black has thus far been commonly effected by the so-called ammonia-acetate method, which, until quite recently, has also been the favorite method employed for the determination of the constituents mentioned in mineral phosphates.

As this method, however, is open to serious objections, it was decided to test its accuracy, and to compare the results obtained with those yielded, respectively, by the method of E. Glaser,[1] and by the combination of Glaser's method with that of A. Stutzer,[2] first suggested by R. Jones[3] for the analysis of fertilizers.

For valuable analytical work performed in this connection, the writer's thanks are due his assistant, Mr. E. C. Brainerd.

The schemes of analysis used in this investigation are minutely given in the following directions:—

Method I. Acetate of ammonia process.

(This method is based on the solubility of calcium phosphate in acetic acid, and on the insolubility of the phosphates of iron and aluminium in this medium.)

1. Powder sample. 2. Dry thoroughly. 3. Weigh out 3.0 grammes. 4. Dissolve in distilled water + 25 cubic centimetres HCl (conc.), boiling gently for one hour. 5. Filter. 6. Wash residue on filter, until the wash-water no longer reacts for Cl with $Ag\,NO_3$. 7. Add excess of $Ba\,Cl_2$, boil till $Ba\,SO_4$ is granular. 8. Filter. 9. Wash the $Ba\,SO_4$ on the filter till no more reaction for Cl with $Ag\,NO_3$. 10. To filtrate and wash-waters combined add NH_4OH, until the precipitate formed begins to appear permanent. 11. Then add acetic acid to pronounced acid reaction, and boil. 12. Filter. 13. Wash the precipitate well. 14. Dry, ignite, weigh. 15. Regard the precipitate as $Fe\,PO_4 + Al\,PO_4$, calculate to $Fe_2\,O_3 + Al_2\,O_3$, and so report.

Method II. Glaser's method.

(In this process the calcium is removed from an alcoholic solution by means of sulphuric acid before the precipitation of the iron and aluminium is effected.)

1. Powder sample. 2. Dry thoroughly. 3. Weigh out 5.0 grammes. 4. Dissolve in distilled H_2O + 30 cubic centimetres H Cl (conc.) + 10 cubic centimetres $H\,NO_3$ (conc.). 5. Make the solution up to 500 cubic centimetres with distilled water. 6. Filter. 7. Of the filtrate take 100 cubic centimetres (equal to 1.00 gramme), place in a 250 cubic centimetre flask, add 25 cubic centimetres $H_2\,SO_4$ (conc.). Shake frequently, and allow to stand for five minutes. 8. Add absolute ethyl alcohol, cool, fill up to the mark with alcohol, and shake well. 9. As volume contraction will take place, fill up to the mark repeatedly with alcohol, and shake each time. Continue this filling up to the mark until no more contraction takes place. 10. Allow the solution to stand for 12 hours. 11. Filter. 12. Of the filtrate take 100 cubic centimetres (= 0.4 gramme), place in a large platinum dish on a water-bath, and heat until all the alcohol is removed. 13. Wash the remaining solution into a beaker with 50 cubic centimetres of distilled water. 14. Heat to boiling, and then remove the flame. 15. Add NH_4OH very carefully to alkaline reaction. 16. Boil until the ammonia is completely expelled. 17. Filter. 18. Wash the precipitate thoroughly with boiling, distilled water. 19. Dry, incinerate, weigh. 20. Regard the precipitate as $Fe\,PO_4$ + $Al\,PO_4$, calculate to $Fe_2\,O_3 + Al_2\,O_3$, and so report.

Method III. Combination of the methods of Glaser and Stutzer.

(Stutzer's method consists essentially in precipitating the iron and aluminium, principally as phosphates, in a solution of ammonium acetate; treating this precipitate with a solution of ammonium molybdate, to remove the phosphoric acid as phospho-ammonium molybdate; filtering out this precipitate, and in the resulting filtrate precipitating the iron and aluminium as hydrates, by ammonium hydrate; drying and igniting this precipitate, weighing it as $Fe_2\,O_3 + Al_2\,O_3$, and reporting it as such.)

The following scheme, it is believed, offers all the advantages of both the Glaser and the Stutzer methods.

Proceed exactly as in Method II. up to and inclusive of section No. 18.

Then continue as follows:—

1. Place filter and contents in a beaker which contains 150 cubic centimetres molybdic solution,[4] at a temperature of about 40° C. 2. Keep the mixture at a temperature of about 65° C. for from 12 to 15 hours. 3. Filter out the precipitate. 4. Wash the precipitate thoroughly with $NH_4\,NO_3$ solution (1:10). 5. To filtrate add $NH_4\,OH$ till it is well alkaline. 6. Heat for 2 or 3 hours over a gentle flame, replacing any loss by evaporation by the addition of water and ammonic hydrate. 7. Filter out the precipitate. 8. Dissolve this precipitate from the filter with H Cl. 9. Precipitate with NH_4OH, and boil out all free ammonia. 10. Filter. 11. Wash precipitate, dry, incinerate, and weigh. 12. Regard the precipitate as $Fe_2\,O_3 + Al_2\,O_3$, and so report.

The mixture on which these three methods were tested consisted of:—

Tri-calcic phosphate	20.00 grammes
Aluminium sulphate	0.10 "
Ferrous sulphate	0.10 "

These amounts of the sulphates of iron and aluminium corresponded to 0.67 per cent of $Fe_2\,O_3 + Al_2\,O_3$, as was ascertained by analysis.

The mixture was dissolved in $H_2\,O$ + H Cl, and made up to 500 cubic centimetres. 24.75 cubic centimetres of this solution contain 1.00 gramme of the dry substance.

In Method I., used 3.00 grammes; in Method II., 1.00 gramme; in Method III., used 1.00 gramme of the "dry substance" for analysis.

Results of Analysis.

		Method.		
		I.	II.	III.
		Per cent.	Per cent.	Per cent.
$Fe_2\,O_3 + Al_2\,O_3$	Present	0.67	0.67	0.67
	Found	0.56	0.60	0.63

Method I. has evidently yielded the least satisfactory result.

[1] Zeitschrift für Angewandte Chemie, 1889, p. 636.

[2] Zeitschrift für Angewandte Chemie, 1890, p. 43.

[3] Chemiker Zeitung, 1890, p. 269.

[4] Dissolve 100 grammes molybdic acid in 40 grammes, or 417 cubic centimetres of ammonium hydrate (sp. gr. 0.96), and pour the solution thus obtained into 1500 grammes, or 1250 cubic centimetres, of nitric acid (sp. gr. 1.20). Keep in a warm place for several days, decant the solution from any sediment, and preserve in glass-stoppered vessel.

Examining into its merits, it is readily seen that this method, as previously stated, is open to several serious objections: phosphate of aluminium is quite soluble in an excess of acetic acid; the precipitate of the phosphates of iron and aluminium is very apt to carry with it some of the calcium salt; the precipitate of the iron and aluminium obtained is not necessarily pure normal ortho-phosphate; and, finally, there is a great risk of introducing an error in calculating the combined phosphates of iron and aluminium over to the sesqui oxides.

The molecular masses of the compounds concerned are:—

$$\begin{aligned} Fe\,PO_4 &= 151 \\ Al\,PO_4 &= 122 \\ Fe_2\,O_3 &= 160 \\ Al_2\,O_3 &= 102 \end{aligned}$$

If the constituents, the iron and the aluminium phosphates, occur in the precipitate in the proportion of their respective molecular masses, i.e., 151 : 122, no error will be committed in assigning to this precipitate of the mixed phosphates the formulæ, $(Fe\,PO_4 + Al\,PO_4)$, and calculating to $Fe_2\,O_3$, as is shown by the following example. Assume the composition of the precipitate to be:—

$$\begin{aligned} Fe\,PO_4 &= 0.151 \\ Al\,PO_4 &= 0.122 \\ \hline Fe\,PO_4 + Al\,PO_4 &= 0.273 \end{aligned}$$

Calculating the combined phosphates over to the combined oxides:—

$$2\,(Fe\,PO_4 + Al\,PO_4) : (Fe_2\,O_3 + Al_2\,O_3) :: .273 : x$$
$$546 \quad : \quad 262 \quad :: .273 : x$$
$$x = 0.131$$
$$\text{i.e., } (Fe_2\,O_3 + Al_2\,O_3) = 0.131$$

Calculating the $Fe\,PO_4$ and the $Al\,PO_4$ separately over to their respective oxide, and then adding them:—

$$2\,Fe\,PO_4 : Fe_2\,O_3 :: 0.151 : x$$
$$302 \quad : \quad 160 \quad :: 0.151 : x$$
$$x = 0.080 \quad Fe_2\,O_3$$
$$2\,Al\,PO_4 : Al_2\,O_3 :: 0.122 : x$$
$$244 \quad : \quad 102 \quad :: 0.122 : x$$
$$x = 0.051 \quad Al_2\,O_3$$

$$\begin{aligned} &0.0800\ Fe_2\,O_3 \\ &0.0510\ Al_2\,O_3 \\ \hline &0.1310\ Fe_2\,O_3 + Al_2\,O_3, \end{aligned}$$

which is identical with the value previously obtained. If, however, the iron phosphate and the aluminium phosphate are present in a proportion different from the one assumed in the above example, the result obtained by calculating their combined weight to combined oxides is wrong. It will be too high or too low, accordingly as the iron, aluminium, or the phosphate predominates.

Example.—Assume that the combined phosphates weighed exactly the same as before = 0.273 gramme; but assume the composition of the precipitate to be:—

$$\begin{aligned} Fe\,PO_4 &= 0.219 \\ Al\,PO_4 &= 0.054 \\ \hline &\ \ 0.273 \end{aligned}$$

Calculating the combined phosphates over to the combined oxides, of course the same result as previously found will be obtained, namely, that

$$\underset{(Fe\,PO_4 + Al\,PO_4)}{0.273} = \underset{(Fe_2\,O_3 + Al_2\,O_3)}{0.131}$$

But calculating the $Fe\,PO_4$ and the $Al\,PO_4$ separately to their respective oxide, there is found:—

$$\begin{aligned} &Fe\,PO_4 \quad 0.219 = 0.1160 \quad Fe_2\,O_3 \\ &Al\,PO_4 \quad 0.054 = 0.0225 \quad Al_2\,O_3 \\ &\left.\begin{matrix} Fe\,PO_4 \\ + \\ Al\,PO_4 \end{matrix}\right\} 0.273 = 0.1385 \left\{\begin{matrix} Fe_2\,O_3 \\ + \\ Al_2\,O_3 \end{matrix}\right. \end{aligned}$$

a higher result than obtained above.

If the composition of the same weight of the combined phosphates of iron and aluminium be assumed to consist of

$$\begin{aligned} Fe\,PO_4 &\ 0.054 \\ Al\,PO_4 &\ 0.219 \\ \hline &\ 0.273 \end{aligned}$$

there will result as before:—

$$\underset{(Fe\,PO_4 + Al\,PO_4)}{0.273} = \underset{(Fe_2\,O_3 + Al_2\,O_3)}{0.131}$$

But,

$$\begin{aligned} &Fe\,PO_4 \quad 0.054 = 0.0286 \quad Fe_2\,O_3 \\ &Al\,PO_4 \quad 0.219 = 0.0915 \quad Al_2\,O_3 \\ &\left.\begin{matrix} Fe\,PO_4 \\ + \\ Al\,PO_4 \end{matrix}\right\} 0.273 = 0.1201 \left\{\begin{matrix} Fe_2\,O_3 \\ + \\ Al_2\,O_3 \end{matrix}\right. \end{aligned}$$

a value considerably lower than obtained by the other method of calculation.

Method II. makes a much better showing than the preceding method. The chief objection to it, is the error involved in weighing the iron and the aluminium as phosphates and calculating them to the oxides, as explained above.

This difficulty, however, could be obviated in the following manner:—

Proceed with the analysis exactly as directed, and weigh the iron and the aluminium as phosphates; then dissolve in $H_2\,SO_4$; reduce the iron by means of zinc and platinum in a $H_2\,SO_4$ solution; titrate with standardized $K_2\,Mn_2\,O_8$ solution, and record the iron as $Fe_2\,O_3$; calculate this to iron phosphate, $Fe\,PO_4$; subtract this value from the weight of the combined phosphates, and then calculate the remainder, the $Al\,PO_4$ to $Al_2\,O_3$.

Method III. has certainly yielded the most satisfactory result, for the difference between the amount of the iron and the aluminium oxides present and determined is only 0.04 per cent, a difference corresponding to less than two-tenths of a milligramme in the actual weight of the precipitate, $Fe_2\,O_3 + Al_2\,O_3$, in this experiment.

The feature which serves as the special endorsement of this method is the fact that the constituents sought are reported in the very form in which they are weighed, and that thus the introduction of errors by calculation is excluded.

In order to test the working of these three methods in actual practice they were applied to the analysis of four samples of bone black.

The results obtained follow:—

Sample.	Method I.	Method II.	Method III.
1	0.65	0.47	0.47
2	0.50	0.44	0.54
3	0.58	0.41	0.46
4	0.48	0.36	0.38

OSTEOLOGICAL NOTES.

BY DANIEL DENISON SLADE, M.C.Z., CAMBRIDGE, MASS.

THE jugal arch in the order of the Cetacea presents some singular modifications. In the Delphinoidea, the squamosal, frontal, and jugal enter into its composition. The squamosal sends forward a large, bulky process which nearly meets the descending post-orbital process of the frontal. The jugal is an irregular flat bone, covered by the maxilla, and sends back from its anterior and internal border a long and very slender process, curved slightly downwards, to articulate with the short, obtuse process of the squamosal, thereby forming the lower boundary of the orbit.

So far as the relations of the squamosal and jugal are concerned, the portion of the arch thus formed is a counterpart of that of the horse; although the union of the two bones is much more complete in the latter animal. The jugal in the horse is relatively a much larger bone, and sends back a well-developed process which underlies that of the squamosal, with which it is joined by a

nearly horizontal suture, thus forming a strong suborbital bony wall.

In the Delphinoidea, the delicate character of the suborbital process of the jugal, and its union with the squamosal, render it difficult at first sight to determine its relation to the arch, and yet, when compared with that of the horse, its homological character cannot be disputed.

In the Balænoidea, much the same conditions are presented, except that the suborbital process of the jugal is both stronger and more curved. The small capacity of the temporal region, as well as the limited extent of the arch in the Cetacea, are correlated with the modifications presented by the mandible, in which the condylar surface is small, and looks directly backwards. There is no ascending ramus, and the coronoid process is quite rudimentary, — all of which conditions are in direct relation to the nature of the food, and absence of the masticatory movements.

The jugal arch in the Sirenia is enormously developed, being composed of the squamosal and the jugal. The former of these is much thickened and presents upon its external face a smooth convex surface.

In the Manatus, this process of the squamosal rests loosely upon the process of the malar, which, underlying it, extends back as far as the glenoid, having first formed a rim which is both suborbital and post-orbital, besides sending a broad plate downwards and backwards, thereby greatly increasing the vertical breadth. The orbital fossa is separated almost completely from the temporal by a bony partition.

The surface for the muscular attachments, both of the temporal and masseter, are extensive, while the pterygoid plates and groove are relatively enlarged. The vertical curvature of the arch is great, but the horizontal is inconsiderable. The ascending ramus of the mandible is broad, compressed, with rounded angle, and surmounted by an obliquely-placed small convex condyle, much raised above the molar series. The coronary surface is broad, directed forwards, and but slightly elevated above the condyle.

In the Dugong (Halicore), the jugal arch is much less massive; there is no post-orbital process from the jugal, and consequently no separation of the orbital and temporal fossæ by a bony orbit. The coronoid process of the mandible looks backward.

Although the horizontal curvature of the arch is very slight in both genera of the Sirenia, the temporal fossæ are deepened and extended — conditions owing to the walls of the cranium being compressed in a lateral direction, which materially increases the extent of surface for muscular attachment and development.

In the order Edentata, the jugal arch also offers unusual modifications. In the Myrmecophagidæ it is very incomplete, being composed of the proximal end of the jugal, articulating with a narrow projecting process of the maxilla, and a very rudimentary fragment of the squamosal. These separate portions, however, do not meet. In fact, they are widely separated. No boundary exists between the orbital and temporal fossæ, the latter being comparatively shallow. The glenoid fossa is a shallow cavity running antero-posteriorly, and well adapted to the pointed, backward projecting condyles of the mandible, whose long, straight horizontal rami present neither coronoid process nor angle. In Cycloturus, the mandible is somewhat arched, and presents a well-marked angular process, as well as coronoid surface slightly recurved.

In the Bradypodidæ, containing the two species Bradypus and Cholœpus, the arch is imperfect, consisting of the jugal, which is narrow at its articulation with the lacrymal and maxilla, but which, widening out into a broad, compressed plate, terminates posteriorly in two processes, the upper pointing backwards and upwards, while the lower looks downwards and backwards. The straight process of the squamosal, although fairly developed, fails to meet either of those of the jugal. There is a post-orbital process of the frontal, which is best marked in Cholœpus. The glenoid is shallow and narrow from side to side. The mandible, widest in Cholœpus, develops a rounded convex condylar surface, well raised up from the dental series, while the coronoid surface is large and recurved. The rounded angular process projects backwards to a considerable extent. The symphysis in both species is solidified, while in Cholœpus it projects forwards into a spout-like process. The temporal surface for muscular attachment is large, as are also the pterygoid plates.

In the Dasypodidæ, the arch is complete, and in its formation the jugal largely enters. This bone extends from the lacrymal and frontal to the process of the squamosal, the anterior third of which it underlies. There is no post-orbital process of the frontal. The glenoid presents a broad, slightly convex, transverse surface. The pterygoids are small. The mandible has a high ascending ramus, the condyle is transverse and high above the alveoli, while the coronoid surface is large and the angle broad and projecting.

In the Manidæ. the jugal arch is incomplete, owing to the absence of the malar, which. if present would occupy almost the exact centre of the arch,—the length of the squamosal process, and that of the maxillary, being nearly equal on either side. The temporal and orbital fossæ form one depression in the side of the skull. The rami of the mandible are slender and straight and without teeth, angle, or coronoid process. The condyle is not raised above the level of the remainder of the ramus.

In the Orycteropidæ the jugal arch is complete. The horizontal curvature is very slight. The post-orbital process is well developed. The mandible rises high posteriorly, with a coronoid slightly recurved. and with an ascending pointed process on the angular edge below the condyle.

In the Marsupialia, the jugal arch is always complete, and composed of the jugal, resting on the maxilla, and squamosal, the first extending from the lacrymal anteriorly to the glenoid fossa posteriorly, of which it forms the external wall. The process of the squamosal passes above the jugal, being united to it by an almost horizontal suture. The horizontal and vertical curvatures of the arch are considerable, and the space for both temporal and masseter muscular insertions is extensive, and the various ridges and crests are extensive, especially in the families of the Dasyuridæ and Didelphyidæ. The post-orbital of the frontal is present as a rule, although in most forms inconsiderably developed. The ascending ramus of the mandible is less elevated than in several of the orders of the Mammalia. The condyle is but little raised above the molar series. The masseteric fossa is extremely projected at its lower external border The mandible has, with one exception, an inverted border to the angle.

In the Monetremata, the Echidnidæ possess an arch in which the squamosal is compressed, and sends forward a slender, straight process to join the corresponding slight, shaft-like process of the jugal. The horizontal curvature of the arch is extremely small.

In the Ornithorynchidæ, the arch is made up of the malar resting upon a process of the maxilla, which, passing straight backwards, unites with the squamosal process that rises far back on the sides of the cranium. While the mandible of the Echidna has but the rudiments of the parts which usually enter into its formation, that of the Ornithorynchus is more fully developed, in relation to the attachment of the horny teeth.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request in advance, one hundred copies of the number containing his communication will be furnished free to any correspondent.

The editor will be glad to publish any queries consonant with the character of the journal.

The Mean Distance of the Earth.

THE interlinear readings to Sir Robert S. Ball's "The Course of an Ice Age" which Miss Hayes gives in *Science* for April 28 have been read and studied with much grateful appreciation by some readers of that book who find the higher mathematics rather slippery ground to walk on without help. On behalf of a group of such readers, I wish to say a few words on the interlinear reading given for the first selection from Sir Robert's book.

The passage is: "There can be no doubt that when the eccentricity is at its highest point the earth is, on the whole, rather nearer the sun, because, while the major axis of the ellipse is un-

altered, the minor axis is least." Miss H. says: "This is equivalent to saying that the mean distance of the earth from the sun is a function of the eccentricity of the earth's orbit, . . ." and then she proceeds to find an expression for this mean distance, first from the standpoint of geology, and, second, from a consideration of the kinematical element of velocity. The result in the first case is that

$$r' \text{ (mean distance)} = a \sqrt{1-e^2},$$

and in the second case that

$$r' = a \sqrt[4]{1-e^2}.$$

From what is said in introducing the second case it appears as if the kinematical result were only an "as it were" mean distance, and not the actual average of all the different distances. If this were so, this part of the article would scarcely supply an interlinear reading for the passage from Ball, for it seems evident that he means the real average distance and not a virtual average. The geometrical result should give the real average, but does it — I mean does Miss H.'s geometrical result give it? This makes it equal to the semi-axis minor, but that surely cannot be true. Of course, it is quite true, and, as Miss H. says, it is easily shown that

$$\frac{1}{\pi}\int_0^{\pi} r\, d\theta = a \sqrt{1-e^2},$$

but she does not show how it is shown that the mean distance

$$= \frac{1}{\pi}\int_0^{\pi} r\, d\theta.$$

As an assumption it does not seem to be convincingly reasonable.

The assumption made in the kinematical discussion seems much more reasonable. It is that the mean distance is the radius of a circle, in the circumference of which a point travels with the same areal velocity as that of the earth in its orbit. If the idea of velocity be dropped, we shall get back from kinematics into geometry, and the same assumption will give us for mean distance the radius of a circle whose area is equal to that of the given ellipse.

Thus $$\pi r_0^2 = \pi a b$$

and $$\therefore\ r_0 = \sqrt{ab} = a \sqrt[4]{1-e^2}.$$

This is the same as Miss H.'s kinematical result, and, like it, agrees with the dynamical result in her equation (4).

ALICE PORTER.

Yarmouth, N.S., May 15.

A Beautiful Spectacle.

I GIVE below a description of a phenomenon seen here on the evening of May 9 and wish you or some of your readers could tell me if it is rare or common, and what is the cause or its relation to other phenomena

On Tuesday evening, May 9, between 9.15 and 9.45 (north latitude 44°, west longitude 66°, but *time* is 60°), we were treated to a curious and beautiful spectacle. Right across the sky from west to east stretched a magnificent arch of luminous radiance. On the west it seemed to spring from a solid mass of black cloud which extended along the whole northwest horizon. Its width was nearly uniform from the western base up beyond the summit, and measured about two degrees. The summit was among the stars of Berenice's Hair, and was 15 to 20 degrees south of the zenith. The eastern branch narrowed as it neared the horizon, and tapered off to a point before quite completing the semi-circle. The color was fairly uniform throughout, and of a grayish or pale-bluish white, some say "yellowish." Except for the cloud-mass in the northwest the sky was beautifully clear, and the brighter stars along each side of the arch seemed to shine out with unusual brilliancy and sparkle. Those covered by the arch were not obscured, but twinkled through it as through a transparent veil. To some observers the summit seemed for a time to move very slowly a little farther south, and near the time of breaking up there were narrow, dark rifts crossing it obliquely; but, on the whole, the entire structure stood remarkably steady, without any of the swaying, or shooting, or shimmering, or wavering motion generally seen in auroras. There had been some auroral outbursts about half an hour earlier, and this phenomenon was probably connected with them. Whatever it was due to, it was a splendid sight — such a sight as the rings of Saturn must be as seen from the surface of that planet — and it was much admired by all who saw it. It broke up and melted away before 10, and in another quarter of an hour the sky was clouded all over.

ALICE PORTER.

Yarmouth, N.S., May 12.

A Fall of Colored Snow.

ON Jan 8 1892, between one and five o'clock P.M., there fell about one inch of colored snow throughout the northern half of La Porte County, Ind.

Mixed with the snow was a large percentage of mineral and vegetable matter giving the snow a reddish-brown hue. Every flake of snow had a particle of this matter, that served as its nucleus, from which the mass became granular. The mass was moist enough to form a crust within twelve hours.

At the time it fell there were six inches of clean snow very evenly distributed over the surface, probably not any surface bare within fifty miles of the above-named area. This old snow was quite compact.

During the next twenty-four hours following the fall of colored snow about four inches of clean snow fell on top of it, and became a crust within a few days, thus embedding the colored snow between two compact strata of ordinary snow, by which it was kept free from contamination for about a month. During that time several persons procured samples of it for examination.

The meteorological conditions at the time of its fall were: Wind from west-southwest; all clouds moved in same direction. Temperature, about zero at 8 A.M. Jan. 8, 12 to 3 P.M., rising; 8 P.M., zero. Thermometer stood at zero Jan. 9. At Chicago from 4 until 4 30 there was light snow, too light to measure. At Grand Haven, Mich., it snowed almost continuously from Jan. 5 to 10; and on Jan. 8, thermometer fell from 18 to 8 above zero (the coldest of the season); while at Chicago it went down as low as 5 below from 12 above zero. That station reports a high-pressure area for the whole northwest country, weather cold and clear. This area closely followed an area of low-pressure, which was central over Upper Lake Michigan during the morning of Jan. 8, moving rapidly northwestward during the succeeding twenty-four hours, general snow marking its passage. The Chicago observing station records wind from west to northwest Jan. 8–9.

Having had my attention called to some of these facts by an article in a local newspaper by Honorable G. H. Teeter of Rolling Prairie, Ind., I began to collect samples, and procured one from that gentleman. I sought to make a survey of the area covered by its fall, but was unable to locate bounds in any direction, although I traced it over an area 35 by 45 miles.

To avoid uncertainty in an analysis of the matter, I drove several miles into the country with Professor F. M. Watters, then science teacher in La Porte High School, to procure samples of it that should not be affected by dust from chimneys and railroads.

I made three analyses of it, besides carefully examining it under the microscope, using both low and high powers. Meanwhile, Mr. Teeter procured an analysis by Professor H. A. Huston, chemist of Indiana Agricultural Experiment Station, at Purdue University, Lafayette, Ind., as follows:—

"Loss on ignition (water and other volatile matter)	15.04
Silica	65.64
Alumina and oxide of iron	15.50
Lime	2.19
Magnesia	1.38
Phosphoric anhydride	.10
Oxide of titanium and undetermined	.15
Total	100.00"

Professor Huston adds: "The composition of the material is such that one is led to believe it to be of volcanic origin, as it approximates very closely to some of the analyses of lava from the

Pacific islands, and from Iceland. I am, therefore, inclined to believe it is a volcanic product."

My analyses approximated Professor Huston's very closely, though I found mica scales, a trace of sulphur, in one analysis, with nearly one per cent vegetable matter in my first sample analyzed (this one procured from Mr. Teeter).

In precipitating the matter by melting the snow, the heavier portions fell to the bottom, and unless care was used the larger portion of the vegetable matter would be lost through being poured off. I found the coarser grains of silica (white sand) to be water-worn and scratched. Lime particles adhered to the sand-grains, just as one finds on the shores of lakes or rivers. Of the vegetable matter, I found the seed of a wild pea (Lathysus ochroleucus), growing abundantly all over the Northwest. This seed, to make sure of no mistake I planted and grew the vine to maturity. Among wood-fibres identified were poplar (Populus tremuloides), pine (Pinus strobus), and casex (Casex tenella).

Now as to the source of this matter. It is plainly terrestrial; and, as the whole area traversed by the winds that carried it were covered with snow at the time, it is evident that it could not have been raised east of Lake Michigan. Its constituent elements preclude all possibility of its being meteoric or volcanic matter.

The fact that the sample analyzed by Professor Huston closely approximates certain volcanic samples can easily be accounted for on the ground that the precipitated mass was not homogeneous, and what was sent him could only have represented a portion of the mass, as another portion of it, sent to me by Mr. Teeter, out of the same lot, contained one per cent of vegetable matter, mica scales, and three small copper pyrites (yielding sulphur on ignition).

Every element of this matter is met with in abundance throughout all portions of the Northwest, and nowhere else do we find all of them on the surface. I conclude that this volume of matter must have been raised somewhere northwest, being carried south-eastward until it encountered the area of high-pressure that extended north of Chicago, and deflected in its course and fell within the area mentioned above.

Can anyone throw more light on the subject?

A. N. SOMERS.

La Porte, Ind., March 21.

The Aurora.

I HAD thought that no matter what Professor Ashe might say in regard to my note printed in *Science* for April 28, I would refrain from further comment. Inasmuch, however, as he in effect demands that something further be said, as appears in the closing paragraph of his note printed in *Science* for May 19, p. 277, I presume that I have no option but to comply. The point to which he asks special attention is as to the element of "chance" affecting the conclusions at which I have arrived respecting the location upon the sun of the seat of the activities originating the aurora in any given instance. The manner in which he puts this inquiry, as well as the general drift of his criticism, shows that I have failed to make myself understood in spite of very persistent efforts in the various notes and papers which he mentions, and which certainly, therefore, must have been taken into consideration in the comments made in the letter above mentioned. This being the case it will be necessary to begin at the beginning and state the heads of the argument by which my conclusions have been reached, so that if there is any flaw in the reasoning its precise location may appear and so that it may be explained also once again what are the precise conclusions for which I have been contending. The substance of the argument, stated in a few propositions as briefly as possible, is as follows: The agreement between the curves, representing the frequency of auroras, magnetic storms and sunspots is exact, and the nature of these phenomena is such that there can be no doubt whatever that the aurora owes its origin to a special form of solar activity. This proposition can be controverted successfully only by denying that there is such agreement as is claimed of the curves mentioned, or by advancing some alternative explanation of their connection with each other which will leave solar activities out of the question. Until this is done, this proposition must stand, the evidence in its favor being adequate and there being no evidence pointing in a different direction. The solar origin of the aurora being thus established, its manifest periodicity at intervals of 27¼ days must be explained in accordance with its solar origin. If this can be done, the proof of such origin will incidentally be greatly strengthened. Now this period is totally indistinguishable from that of a synodic revolution of the sun — giving every evidence of being absolutely the same. This being the case we are able to formulate proposition number two to the effect that there is a periodicity of the aurora corresponding to the time of the rotation of the sun as seen from the earth. Here again the evidence is adequate and there is no evidence pointing to any other possible explanation. These two propositions being established there follows another, from which there is in the very nature of the case no possibility whatever of escape, and which is to the effect that whatever it is upon the sun which is capable of producing the aurora, it has this power during a very limited portion only of each revolution, which portion always remains the same during succeeding revolutions relative to the position of the earth in its orbit, otherwise the periodicity described could not exist. It remains only to identify the point whence the auroral effect proceeds. The period of auroral recurrence and that required for the completion of a synodic revolution of the sun as determined from the average rate of motion of spots being identical, there is no other way than to study the appearance of the sun at times of auroral recurrence in order to learn whether such recurrence is attended by any characteristic features. Thus it is found that no matter what appears elsewhere on the sun at such times there are always at the eastern limb areas on which spots are frequent and persistent. Thus the evidence is adequate that there must be something in that location in such cases which is responsible both for the sunspots and the aurora, and there is no evidence pointing in any different direction. On the contrary, the manner in which magnetic storms begin and the exactness of the periodicity manifest in their times of beginning are such as are totally inconsistent with any other explanation than that the originating impulse is brought to bear by coming into range suddenly around the sun's limb. But be this as it may, such behavior corresponds precisely with what is known in regard to the operation of electro-magnetic induction in which very precise arrangements of lines of force and development of poles in certain directions in the case of rotating bodies, or otherwise, are the rule, and there is no correspondence whatever to the mode of action of any other force of which we have knowledge. Thus at no point throughout the research, as above outlined, has there appeared to be even the slightest "chance" for an alternative hypothesis. The evidence in favor of each proposition stated has been adequate and all in one direction, and moreover, taken together it is cumulative; each point strengthening the others and nowhere developing any inconsistencies. Professor Ashe is mistaken in stating that there has been "no attempted refutation." I have letters and articles by the score from persons who started in with vehemence, some of them many years ago, but who have gradually become very respectful, finally being brought to a realizing sense, that it is facts and not a personality against which they had been contending.

M. A. VEEDER.

Worms in the Brain of a Bird.

APRIL 7th, 1890, two common Bitterns (*Boturus mugitans*) were brought to me to be mounted. One of them was still alive but did not seem to be just natural, seemed to lack what we might call bird intelligence, and was smaller than the other and poor in flesh. This bird was given to one of my pupils in taxidermy, Miss Bernice Pike, to mount. When the head had been skinned and was ready to sever from the neck, which was done by cutting through the skull, the brain-cavity was found to contain a mass of thread-worms, occupying about one-third of the brain cavity. These were seemingly like the ordinary Gordius or Hair Snake, about the size of a Gordius that is three inches long, and coiled in a mass in the upper posterior part of the brain, and extending some down into the spinal canal. As near as I could say without removing them, they occupied the subarachnoid space,

and had absorbed much of the cerebrum and the upper part of the cerebellum, the outlines of the Arbor Vitae being plainly visible. I have never seen anything like this in any other bird, nor have I seen any account of worms being found parasitic in the brain before. G. H. FRENCH.

Carbondale, Ill.

Epidemic Forms of Mental or Nervous Diseases or Disorders.

IN response to the inquiry concerning "epidemic forms of mental or nervous diseases or disorders," in the issue of May 19, I send the following account of an incident which "came to pass" under my own eyes. Several years ago our next-door neighbor's little girl, perhaps five or six years old, met with an accident which rendered it necessary that she use a crutch. Another little girl of about the same age, who lived in the adjoining house, seeing the little lame girl with her crutch, obtained a stick which she used as a crutch, hopping and limping, just as she saw the little lame girl doing. At first no attention was paid to this childish fancy, this imitation, this "playing being lame." After some days had elapsed, however, and this play became so constant as to be annoying, the stick was taken away, and the little girl told to put her foot to the floor. She screamed and cried and insisted most strenuously that she could not put her foot to the floor: she could not stand upon it, etc. I cannot say how long she persisted in thinking she was lame, but shall never forget how real her apparent affliction was to her, nor her screams of pain when she declared she could not stand without her "crutch" MRS. W. A. KELLERMAN.

Columbus, O.

The Winter of 1709.

"IN the famous winter of 1709 thousands of families perished in their houses, the Arabic Sea was frozen over, and even the Mediterranean."

The above is found in a foot-note on page 39 of Professor Meech's article on the intensity of the heat and light of the sun at different latitudes, published in one of the "Smithsonian Contributions to Knowledge." It seems incredible The "Arabic Sea," I take it, is what we call the Arabian Sea, or at least some one of the bodies of water which border on the Arabian peninsula. No information is given as to where the "thousands of families perished with cold in their houses."

The Arabian Sea measures about 500 miles across its narrowest part. Can it be possible that it was frozen over? or the Red Sea? or the Persian Gulf? or the Gulf of Oman? Has the Mediterranean Sea been frozen over either in historic, or even in glacial times?

The statement in Professor Meech's paper is made unequivocally, as if speaking of a well-known and well-established fact. It is not put in quotation marks, nor is any authority cited.

A few weeks ago I wrote to Professor Langley, secretary of the Smithsonian, asking for any information which he might be able to give me To-day I received the following reply:—

"I beg to say that I do not know the original source from which his particular statements were derived, but that the winter in question was one of exceptional severity is fully attested by well-authenticated records.

"Under the article 'Temperatur,' in Gehler's 'Physikalisches Wörterbuch,' it is stated that at Paris the thermometer fell many times to $-19°$ C.; that in the Kleiner Belt of the Danish seas the ice extended so far from the coast that the end of it could not be seen from the highest towers; and that the cold must have been especially intense in southern Germany and Italy, since the Adriatic Sea was wholly covered with ice.

"Additional records of this severe winter will probably be found in the memoirs of E. Brückner, who has been making an extended study of variations in climate."

There is nothing in the fact that at Paris the thermometer fell to $-19°$ C., or $3\frac{1}{2}°$ below our zero, nor that in the Danish waters ice formed far out from the coast to compare in any way with the freezing over of "the Arabic Sea or the Mediterranean!"

The fact—if it be a fact—that the Adriatic Sea was wholly covered with ice would indeed be very remarkable, but even that was a small affair (indicating a moderate climatic aberration) in comparison with a temperature so abnormally low as to freeze over so large a body as the Mediterranean, or one so large and so exceptionally warm as the Arabic Sea.

Can any reader of *Science*, or any one else, throw any light on this subject? C. B. WARRING.

Animal Effigies.

CAN you or any of your readers furnish me with a reference or references as to large numbers of small animal effigies of pottery found together in any mound of the United States? C. B. M.

BOOK-REVIEWS.

The Moon's Face: A Study of the Origin of its Features. By G. K. GILBERT. 52 p. Washington, April, 1893.

THE present paper, although delivered as the presidential address before the Philosophical Society of Washington last December, has only recently been distributed in its complete form. Mr. Gilbert is well known as a geologist and a student of topographic form, and in this paper he has carried his studies away from things terrestrial and turned his eyes and his attention for a time to things celestial. The observations upon which the paper is based were made during three months of the past year, eighteen nights being available for the work, and the $26\frac{1}{4}$-inch refractor of the U. S. Naval Observatory being the instrument employed. Numerous laboratory experiments were also carried on, and the literature relating to lunar topics was searched. The craters, as the most conspicuous features of the moon's face, are mainly dealt with in the paper, and after a description of their characteristics and a statement of the various theories advanced to account for them, the author advances a theory of his own. The volcanic theory is one held by many writers, but a comparison of terrestrial and lunar craters, even when the differences in condition are considered, led Mr. Gilbert to reject the hypothesis as untenable. The "bubble" theory, advocated by Robert Hooke in his *Micrographia*, in 1667, is mentioned, but as Mr. Gilbert had not seen the book the theory is not discussed in any detail. It may not be amiss to devote a few words to it here.

Hooke describes the features of the craters as he saw them through his telescope, and gives an illustration of some of them. Except as regards detail and the characteristic central hill shown in Mr. Gilbert's figures, those given by Hooke are very similar. In describing the craters he says: "These seem to me to have been the effects of some motions within the body of the moon, analogous to our earthquakes, by the eruption of which, as it has thrown up a brim or ridge round about higher than the ambient surface of the moon, so has it left a hole or depression in the middle, proportionally lower." He also mentions, what is of more interest, that he had made several experiments to ascertain, if possible, the origin of the pits. "The first was with a very soft and well-tempered mixture of tobacco-pipe clay and water, into which, if I let fall any heavy body, as a bullet, it would throw up a mixture round the place, which for a while would make a representation not unlike these of the moon, but considering the state and condition of the moon, there seems not any probability to imagine that it should proceed from any cause analogous to this; for it would be difficult to imagine whence those bodies should come; and next, how the substance of the moon should be so soft; but if a bubble be blown under the surface of it, and suffered to rise and break; or if a bullet or other body sunk in it be pulled out from it, these departing bodies leave an impression on the surface of the mixture exactly like those of the moon, save that these also quickly subside and vanish. But the second and most notable representation was what I observed in a pot of boiling alabaster, for then that powder being by the eruption of vapors reduced to a kind of fluid consistence, if, whilst it boils, it be gently removed beside the fire, the alabaster presently ceasing to boil, the whole surface, especially that where some of the last bubbles have risen, will appear all over covered with small pits exactly shaped like these of the moon, and by holding a lighted

candle in a large dark room, in divers positions to this surface, you may exactly represent all the phenomena of these pits in the moon, according as they are more or less inlighted by the sun." He then goes on to advocate the second theory, and concludes finally that the craters had their origin similar to those formed in the alabaster.

A "tidal" theory, which supposes a time when a thin crust concealed a liquid beneath, which was moved by the action of tides in such a manner as to produce craters, is also examined and rejected by Mr. Gilbert. So also is a "snow" theory, and then are considered the "meteoric" theories, which suppose the pits to have been caused in some way by the impact of extra-lunar bodies. As we have seen, this theory was considered and rejected by Hooke in 1667, but others have not seen the same difficulties that he did. Mr. Gilbert advances the following theory:

"It is my hypothesis that before our moon came into existence the earth was surrounded by a ring similar to the Saturnian ring: that the small bodies constituting this ring afterward gradually coalesced, gathering first around a large number of nuclei, and finally all uniting in a single sphere — the moon. Under this hypothesis the lunar craters are the scars produced by the collision of those minor aggregations, or moonlets, which last surrendered their individuality."

This hypothesis was tested in numerous ways, and it was found

CALENDAR OF SOCIETIES.

Philosophical Society, Washington.

May 27. — S. P. Langley, On Recent Observations in the Infra-red Spectrum; G. K. Gilbert, The Average Temperature of the Earth; Cleveland Abbe, The Formation of Rain.

Chemical Society, Washington.

Apr. 13. — Subject for discussion: Organization as a Section of the American Chemical Society; G. L. Spencer, A New Drying Oven. The walls of the oven are made double and the space between them filled with a non-conducting substance. The bottom of the oven is also made double, the outer wall being made of Russia iron and the inner of copper. The space between is filled with air. This oven has lately been devised in Dr. Peale's laboratory by Dr. G. L. Spencer. The drying bulbs are made in the shape of a flask with rounded bottom. The content of the flask varies from 150 to 200 cubic centimetres. From six to eight of these drying flasks are connected *en batterie* with the pump. If a current of hydrogen is to be introduced into the drying flask, it is easily accomplished by passing a very small glass tube through the cork, joined to another tube by a rubber connection immediately below the cork. The inner tube should pass nearly to the bottom of the flask, passing through a wash bottle containing caustic soda, and then through a sulfuric acid bulb. The speed of the current, which need not be very great, is controlled by a stop or pinch-cock. Any of the sample which may touch the inner tube during the intumesence, caused by desiccation, remains thereon and is weighed at the end with the tube, which is detached and left in the drying bulb. H. W. Wiley, A New Lamp for Securing a Constant Monochromatic Flame. This lamp was devised to secure a constant uniform coloration for polarimetric observations. It consists essentially of two wheels with platinum gauze perimetres and spokes, driven by a clock-work and mounted as shown in the figure. The sodium salt, chlorid or bromid, is saturated in solution, is placed on the porcelain crucibles to such a depth that the rims of the platinum wheels dip beneath the surface as they revolve. By means of the crossed bands the wheels are made to revolve in opposite directions, as indicated by the arrows. The solution of the salt, which is taken up by the platinum net-work of the rim of the wheel, thus has time to become perfectly dry before it enters the flame, and the sputtering, which a moist salt would produce, is avoided. At every instant, by this arrangement, a minute fresh portion of salt is introduced into the flame, with the result of making a perfectly uniform light, which can be used for hours without any perceptible variation. The polariscope should be so directed toward the flame as to bring into the field of vision its most luminous part. The platinum wheels are adjustable, and should be so arranged as to produce between them an unbroken yellow flame. H. B. McDonnell, A Filter for Fine Precipitates. To prepare the ordinary Gooch filter for the retention of fine precipitates, the writer adds a little powdered asbestos on top of the ordinary asbestos felt in the bottom of the perforated crucible. The fine asbestos can be purchased from dealers in chemicals, and should be an impalpable powder. It is prepared for use by treating with acid, to remove all soluble matter, and washed a few times by decantation. It is kept in water, in which it is suspended, by agitation, just before use. A filter prepared in this manner will perfectly retain barium sulphate, even when it is precipitated cold and filtered at once.

May 11. — The society amended the constitution and by-laws so as to conform it to the requirements of the constitution of the American Chemical Society, in order to become a local section of that society. Oma Carr, The Predominant Organic Acid in Acid Juices. A tenacious, difficultly soluble incrustation forming upon the tubes of the multiple-effect evaporator at the Medicine Lodge Sugar Works, Medicine Lodge, Kansas, was examined, first with regard to the practical problems connected with its removal, and, second, with regard to its composition, particularly the organic acid in combination with the magnesium and calcium of the scale. The incrustation contained a high percentage of organic matter — 54.4 per cent, of which 43.5 per cent was carbon, or 23.7 per cent on the original material. Sulfuric and acetic acid digestions of the scale were made, the magnesium salt of the prevalent organic acid isolated and converted into a repeatedly purified lead salt. Combustion of these salts rendered results concordant with the theoretical composition of tri-plumbic citrate. Aqueous solution of the acid gave reactions confirmatory of the combustions. Inasmuch as the scale may be taken as an index of the predominant acid combined with the magnesium of the scale, the assumption is plausible that the predominant acid is citric, and not aconitic, as has been commonly supposed. H. W. Wiley, On the Estimation of Levulose in Honey. The principal methods of estimating levulose in the mixtures heretofore practised are those which consist in the destruction of some of the ingredients in the mixture and the estimation of the remaining one, or the method of Wiechmann, which consists in the estimation of the polarizing and reducing power before and after inversion. Neither of these methods can be applied to honey, which contains other optically active bodies besides cane-sugar, levulose, and dextrose. The method presented rests on the principle of the change in the specific rotatory power of honey, due to temperature; the other optically active bodies present remaining practically unchanged, as far as specific rotatory power is concerned, with changes of temperature. Polarizations of many samples of honey were made at intervals of 10 from 0 to 88. The temperature at 88 was chosen as the maximum temperature, because at that temperature a pure invert sugar, composed of equal parts of levulose and dextrose, becomes optically inactive. In other words, the specific rotatory power of levulose at 88 is the same as that of dextrose. A chart was shown giving a graphic representation of the changes in rotatory power, due to temperature. The chart shows that from 20 to 88 the changes are practically equal for either increments or decrements of temperature. From 20 to 0 there is a slight curve, showing a small deficiency in rotatory power at 0 from that which would be calculated from the rate of change from 88 to 20. A table was shown giving the results of the calculation of the per cents of levulose in various samples of honey by this method, which were very satisfactory.

to agree with most of the features of the moon. We cannot, however, enter into further details or explanations that are given of various other objects, interesting though they be. We can only quote one of the concluding paragraphs, as this gives some idea of the difference in conclusions which result from the study when compared with those of other authors. He says: "This sketch of the life of our nearest neighbor has but little in common with the accounts of other biographers. To her has been ascribed a fiery youth, after the manner of the sun, a middle life of dissipation, like Jupiter and Saturn, a hardening and wrinkling old age, toward which the earth is tending, and finally, the end of change—death. If the record of her scarred face has now been read aright, all that remains of the old narrative is the *denouement*: the moon is dead." JOSEPH F. JAMES.

The Mineral Industry. Its Statistics, Technology, and Trade, in the United States and other countries from the earliest times to the end of 1892. Vol. I. Edited by Richard P. Rothwell. New York, The Scientific Publishing Company. 1893. 628 p.

IN the years of 1874–75 and '76 *The Engineering and Mining Journal* of New York published the first complete reports of the coal production of the United States, and in 1889 as special government agent for the census, the editor of the journal, Mr. Richard P. Rothwell, collected the statistics of gold and silver. The scope was gradually extended until in January, 1892, a magnificent volume of statistics was given to the world and universal encomium heaped upon the journal and its staff for their wonderful work. Indeed such was the unstinted praise accorded it we can but wonder what language will be used for the present volume, no longer a supplementary number in journal form, but a handsome library volume of 628 pages. It is the intention to make this the first of a series to embrace within a few years the statistics and technology of the mineral interests of the world, in many cases going back historically to the earliest times and always carried down to the date of publication. Such a vast undertaking has heretofore been considered impracticable for private enterprise and has been relegated to the unlimited resources of governments, it is worthy to note, however, that simultaneously with the issue of this volume containing all statistics accurately and systematically recorded for 1892, there appears the government publication of similar character for the year 1891. The introduction to this latter volume, by the way, speaks of "the impossibility of concluding a complete canvas of the products of huge industries like coal, iron ores, and building stone without a considerable delay after the close of the year reviewed," and yet the *Engineering and Mining Journal*, depending entirely upon personal courtesy and confidence for its success, has accomplished this feat so impossible to the expensive machinery of government. The journal is fortunate in possessing a large and carefully trained staff, and in being in communication with experts in all branches of industry the world over, but more than this is needed, and much praise is due to all connected with the enterprise. Especially is praise due to Mrs. Sophia Braeunlich, that able financier and business manager of *The Engineering and Mining Journal*, and to Mr. Richard P. Rothwell, editor of both journal and "statistics."

To attempt even a running review of this work would be out of the question, the table of contents alone occupying ten pages of small print. Suffice it to say that without exception the articles therein contained are written by men pre-eminently fitted for their best treatment, and in all cases by experts in each particular line. Among the contributors are: Dr. George Lunge, Dr. Francis Wyatt, author of "The Phosphates of America"; E. O. Leech, Director of the U. S. Mint; Professor J. F. Kemp, George F. Kunz, J. Langeloth, Dr. Thomas M. Chatard, Richard E. Chism. H. O. Hofman, Emile Delecroix, and many others of equal fame. They have been well chosen, and we congratulate them upon the part they have played in this most admirable work. C. P.

Exchanges.

[Free of charge to all, if of satisfactory character. Address N. D. C. Hodges, 874 Broadway, New York.]

The Rev. A. C. Waghorne, New Harbor, Newfoundland, wishes to sell collections of Newfoundland and Labrador plants, all named by competent botanists. He is going on a missionary journey along the Labrador coast, from the middle of July till October. and in return for much needed aid towards (Episcopal) Church purposes in that region, will be glad to be of service to any botanists who may write to him. Letters posted in the U. S. up to July 1 will reach him at the above address, and if posted later will be forwarded.

For sale.—J. D. Dana's Report on Crustacea of the U. S. Exploring Expedition under Charles Wilkes. Text and plates well bound in three volumes, half morocco, $75. Samuel Henshaw, Boston Society of Natural History, Boston, Mass.

For exchange—I wish to exchange cabinet skins of Californian birds or mammals for any book on the following list, books if second-hand to be in good order. Manual of Vertebrates, fifth edition, D. S. Jordan; Nests and Eggs of North American Birds, Oliver Davie; Marine Mammals of the West Coast of North America, C. M. Scammon; The United States and Mexican Boundary Survey, Vol. II., Zoology, S. F. Baird. F. Stephens, Witch Creek, San Diego Co., Cal.

Minerals for exchange—John Holl. Rollo, Wilmington, Delaware.

For sale or exchange.—Johnson's Universal Cyclopædia, 8 vols., ed. 1888. Binding, half-morocco. Will sell cheap for cash or would exchange for typewriter. Address W. J. McKom, Mason, Mich.

I have 500 microscopic slides to exchange in lots to suit. Want Kodak, first-class field-glass or scientific books. A. C. Gruhlke, Waterloo, Ind.

Texas Plants. I will collect sets of plants represented in this region of Texas, either for sale or for exchange for literature, for anyone who will send me an order in time to fill it. Plants to be ready complete in November. C. F. Maxwell, Box 174, Dublin, Texas.

For sale or exchange—A Telescope (36 diameters, copper barrel)—for $20 cash or scientific books of that value. A. N. Somers, La Porte, Ind.

For sale—A complete set of the Reports of the Second Geological Survey of Pa., 1874–1888, including the Grand Atlas. Publisher's price over $115. Will sell for $50. Address F. D. Chester, Newark, Del.

Wants.

WANTED.—Second-hand copy of Ehrenberg's Radiolaria, Berlin. 1875. Selected diatom slides, cash or both in exchange. D. C. Lewis, M.D. Skaneateles, N. Y.

WANTED, as principal of a flourishing technical school, a gentleman of education and experience who will be capable of supervising both mechanical and common school instruction. Special familiarity with some technical branch desirable. Address, giving age, qualifications, etc., J. B. Bloomingdale, Fifty-ninth street and Third avenue, N. Y.

WANTED.—A young man as assistant in our microscopical department. Queen & Co., Philadelphia.

THE undersigned desires specimens of North American Gallinae in the flesh for the study of their pterylosis. These species are especially desired: *Colinus ridgwayi, cyrtonyx montezumae, deudragapus franklini, lagopus welchi, tympanuchus cupido* and *pedioecetes phasianellus.* Any persons having alcoholic specimens which they are willing to loan or who can obtain specimens of any of the above are requested to communicate with Hubert Lyman Clark, 3622 Fifth Avenue, Pittsburgh, Pa.

A COMPETENT TEACHER of botany in college or university is open to engagement. Address L., Box 86, Rochester, Mich.

CAN any one inform me as to the age to which cats have lived? I have one twenty years old. Edward D. Webb, 182 W. Eighty-first St., New York.

WANTED—Second-hand. Foster's Physiology, Balfour's Comparative Embryology, Claus & Sedgwick's Zoology, Flower's Osteology of Mammalia, Vine's Physiology of Plants. Please state editions and prices asked and address Richard Lees Brampton, Ontario, Canada.

A GRADUATE ENGINEER will give instruction evenings in geometry, trigonometry and surveying, mechanics, physics, mechanical drawing and general engineering construction. Five years' experience in field and editorial work on engineering journal. References furnished. C. S. H., 102 Tribune Building, New York.

THE American Bell Telephone COMPANY.

125 MILK ST., BOSTON, MASS.

This Company owns the Letters-Patent No. 186,787, granted to Alexander Graham Bell, January 30th, 1877, the scope of which has been defined by the Supreme Court of the United States in the following terms:

"The patent itself is for the mechanical structure of an electric telephone to be used to produce the electrical action on which the first patent rests. The third claim is for the use in such instruments of a diaphragm, made of a plate of iron or steel, or other material capable of inductive action; the fifth, of a permanent magnet constructed as described with a coil upon the end or ends nearest the plate; the sixth, of a sounding box as described; the seventh, of a speaking or hearing tube as described for conveying the sounds; and the eighth, of a permanent magnet and plate combined. The claim is not for these several things in and of themselves, but for an electric telephone in the construction of which these things or any of them are used."

This Company also owns Letters-Patent No. 463,569, granted to Emile Berliner, November 17, 1891, for a combined Telegraph and Telephone, and controls Letters-Patent No. 474,231, granted to Thomas A. Edison, May 3, 1892, for a Speaking Telegraph, which cover fundamental inventions and embrace all forms of microphone transmitters and of carbon telephones.

BUSINESS OPPORTUNITY.

There is an opening for a young man to open a New York office of the American Lightning Protection Co., operating under my patents. But little capital will be required.

N. D. C. HODGES,
874 BROADWAY, NEW YORK

ABOUT MAGIC LANTERNS ASK US WE MAKE THEM
J. B. COLT & CO.
16 BEEKMAN ST. 189
NEW YORK

MINERALS. New Store. New Stock. New Departments.

Send for our "Winter Bulletin," recently issued. Minerals, Gems, Microscopical Sections, Fine Lapidary Work.

GEO. L. ENGLISH & CO., Mineralogists,
Removed to 64 East 12th Street, New York.

LIGHTNING DESTROYS!

Shall it be your house or a pound of copper?

Entirely new departure in protecting buildings from lightning.

One hundred feet of the Hodges Patent Lightning Dispeller (made under patents of N. D. C. Hodges, Editor of *Science*) will be sent, prepaid, to any address, on receipt of five dollars.

Correspondence solicited. Agents wanted.

AMERICAN LIGHTNING PROTECTION CO.,
874 Broadway, New York City.

Fact and Theory Papers

I. THE SUPPRESSION OF CONSUMPTION. By GODFREY W. HAMBLETON, M.D. 12°. 40c.

II. THE SOCIETY AND THE "FAD." By APPLETON MORGAN, Esq. 12°. 20 cents.

III. PROTOPLASM AND LIFE. By C. F. COX. 12°. 75 cents.

IV. THE CHEROKEES IN PRE-COLUMBIAN TIMES. By CYRUS THOMAS. 12°. $1.

V. THE TORNADO. By H. A. HAZEN. 12°. $1.

VI. TIME-RELATIONS OF MENTAL PHENOMENA. By JOSEPH JASTROW. 12°. 50c.

VII. HOUSEHOLD HYGIENE. By MARY TAYLOR BISSELL. 12°. 75 cents.

N. D. C. HODGES, Publisher,
874 Broadway, New York.

QUERY.

Can any reader of *Science* cite a case of lightning stroke in which the dissipation of a small conductor (one-sixteenth of an inch in diameter, say,) has failed to protect between two horizontal planes passing through its upper and lower ends respectively? Plenty of cases have been found which show that when the conductor is dissipated the building is not injured to the extent explained (for many of these see volumes of Philosophical Transactions at the time when lightning was attracting the attention of the Royal Society), but not an exception is yet known, although this query has been published far and wide among electricians.

First inserted June 19, 1891. No response to date.

N. D. C. HODGES, 874 BROADWAY, N. Y.

SCIENCE CLUBBING RATES.

10% DISCOUNT.

We will allow the above discount to any subscriber to *Science* who will send us an order for periodicals exceeding $10, counting each at its full price.

N. D. C. HODGES, 874 Broadway, N. Y.

"BUSY FOLKS' GYMNASIUM."

A few minutes' daily exercise on our fascinating apparatus clears the brain, tones up the body, develops weak parts. Our cabinet contains chest-weights, rowing-weights, lifting-weights, clubs and dumb bells, adjustable for old and young. *It is the only complete exercising outfit in the world* suitable for use in living rooms. All prices. You can order on approval. Chest machine separate, $4.50 and up. Educated agents wanted. PHYSICAL CULTURE CHART, with illustrated directions for developing every part of the body healthfully, 50 cts. Sent for half price to those naming this paper.

6
Shoulders and Upper Back, good for Round Shoulders.

WHITNEY HOME GYMNASIUM CO., Box D., Rochester, N. Y.